WA Commercial Building Energy Performance Standards – Draft EUI Target Methodology

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Presented at: Smart Buildings Center

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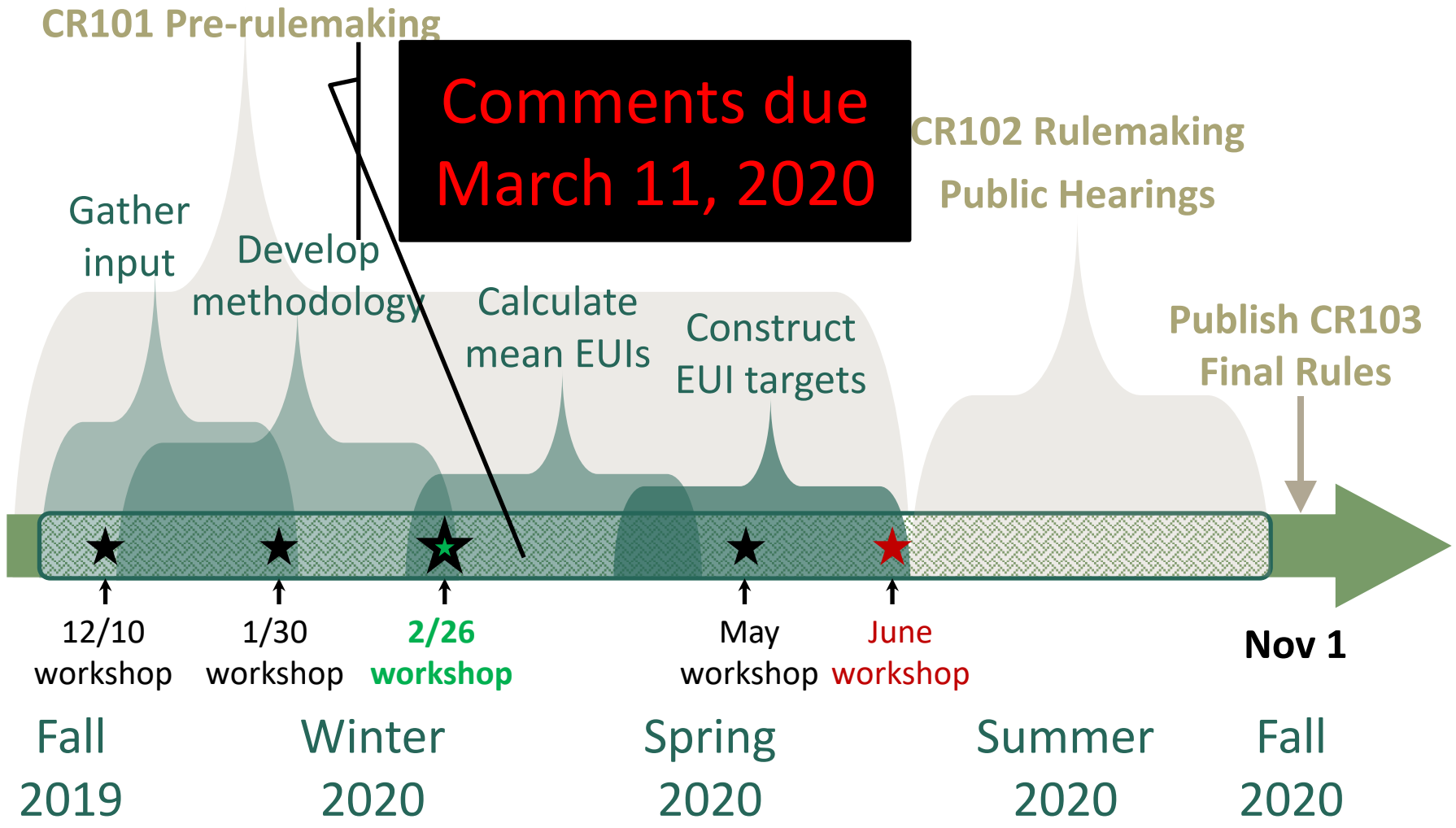
Agenda:

- EUI Target Development Process & Timeline
- Recap of Public Input
- Target Setting Criteria
- Analysis Platform
- EUI Target Methodology
  - Step 1: Generate Mean EUIs by Building Type & Climate Zone
  - Step 2: Develop Normalization Factors & Adjustments
  - Step 3: Calculate EUI Targets
- Final Targets & Reporting
- Considerations for a Future Policy Framework

EUI Target Development Process



Recap of Public Input

TARGET SETTING CRITERIA

Target Setting Criteria

- Equal to or less than mean EUIs
- Maximize GHG reductions
- Trigger market response and critical mass for capacity building
- Informed by possible future framework for predictable updates

Market Adaptation Considerations

- Technical path to reductions
- Market readiness, capacity, and alignment
- Utility program readiness and alignment
- Allow for whole building optimization across fuel types
- Alignment with WSEC
- Alignment with other programs, certifications, and policies
- Encourage early adopters to go further
- Alignment with energy management planning horizons
- Accessible financing mechanisms

ANALYSIS PLATFORM

Analysis Platform

- Collect Data & Assemble Analysis Tables
- Account for Key Determinants of Energy Use (DEU)
- Confirm Building Typology & List of EUIt Building Types

Collect Data & Assemble Analysis Tables

Data Sources	Purpose
2012 Commercial Building Energy Consumption Survey (CBECS)	Starting point mean EUIs; for analyzing variations in energy use and determining normalization factors/adj.
2019 Northwest Commercial Building Stock Assessment (CBSA)	Regional cross check for CBECS means and possible adjustments; for analyzing variations in energy use and determining normalization factors/adj.
2014/2007 CBSAs	Will use 2014/2007 CBSAs if 2019 if not available yet
Northwest Multifamily Residential Building Stock Assessment (RBSA)	Establishing multifamily mean EUIs
City of Seattle Benchmarking Data	Regional cross check for CBECS means and possible adjustments; for analyzing variations in energy use for determining normalization factors/adj.
City of Portland Benchmarking Data	Regional cross check for CBECS means and possible adjustments
2006 New Construction Modeled Baselines by State Building Code Council (SBCC)	Newer construction EUI means
Other data sources as required	Based on our review of the energy use sources included here, we may augment this list with additional sources.
Misc. data available from 2021 NW Power Plan development (e.g. pop. data, end use EUIs, fuel splits)	For assessing aggregate GHG impacts of EUI target scenarios

Determinants of Energy Use (DEU)	How Key Determinants of Energy Use Will Be Addressed:					
	Normalization Factors	Weighted Average EUIt	Exempt from HB1257	Built in to Mean EUI	New(er) Construction EUIt	Explore Variations in Energy Use to ID Need for Adjustments
Buildings w/ multiple activities (Mixed Use)		X				
Small % of floor area driving bldg energy use (servers, labs, restaurants, laundry)		X	*			
Vacancy		X	*	X		
Occupancy Density				X		X
Operating Shift	X			X		X
Building Type				X		
Building Size				X		X
Standard Loads			*	X		
Unique Loads			*			X
Climate/Weather				X		
Campus (master metered, central plant)		X		X		
Industrial/Manufacturing			X			
Vintage					X	X
Heating Fuel Type/Conditioned area				X		X
Onsite Renewables				X		

Confirm Building Typology & List of EUIt Building Types

- Use Energy Star Portfolio Manager (Energy Star PM) typology
  - Categories, types, and subtypes
  - Terms and Definitions
- Create a typology crosswalk across Energy Star PM, CBECS, and CBSA
- Use CBECS to define a list of building types with enough granularity to develop EUI means and targets
  - Consider collapsing some building types where EUI variations are small within a larger category.
- Use typology crosswalk to extend EUI targets to relevant Energy Star PM categories and types

Example of Energy Star PM Crosswalk with CBECS

ENERGY STAR® Portfolio Manager®

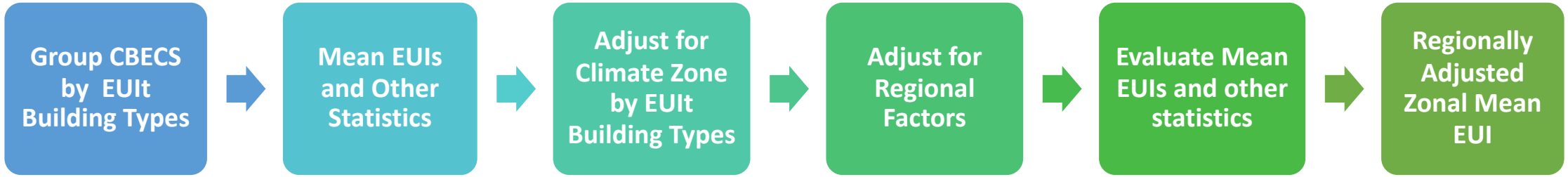
Technical Reference

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Entertainment/Public Assembly	Stadium	Indoor Arena	112.0	56.2	CBECS - Public Assembly
		Race Track			
		Stadium (Closed)			
		Stadium (Open)			
		Other - Stadium			
	Other	Aquarium			
		Casino			
		Zoo			
		Other - Entertainment/Public Assembly			

EUI Target Methodology

STEP 1: GENERATE MEAN EUIS BY BUILDING TYPE & CLIMATE ZONE

Mean EUI Development Overview



Assemble CBECS Mean EUIs for EUIt Building Types

- Group CBECS data by **EUIt building types**
- Find the statistical characteristics for each group
  - Mean EUI, Population, Standard deviation, etc.
  - Statistics form the basis for evaluating additional adjustments

Make Climate Adjustments to Derive Zonal CBECS Mean EUIs

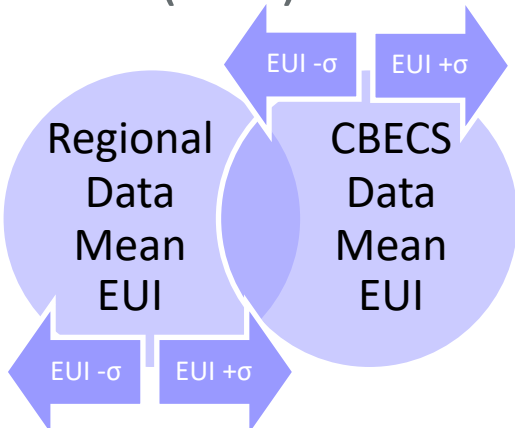
- ASHRAE climate zone factors
  - Select ratios for each of the EUIt building types to adjust for WA climates
- Apply climate zone factors
  - Apply factors to 2012 CBECS Mean EUIs for each EUIt building type

Table J-1 Ratios of Climate Zonal EUI to Average of All EUIs by Building Type

ASHRAE Climate Zone:	1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C
Building Type	Climate Zone EUI Ratio									
All Office	0.91	0.94	0.91	0.97	0.76	0.90	0.78	1.06	0.92	0.94
Large Office	0.88	0.95	0.88	0.98	0.80	0.89	0.81	1.07	0.88	0.98
Medium Office	0.98	0.97	0.98	0.97	0.78	0.93	0.77	1.05	0.91	0.93
Small Office	0.87	0.90	0.89	0.95	0.71	0.89	0.75	1.06	0.96	0.91
Warehouse	0.52	0.66	0.69	0.84	0.45	0.75	0.61	1.13	0.95	0.92

Compare CBECS Zonal Mean EUIs to Regional Datasets

- For comparing with regional datasets, aggregate CBECS zonal mean EUIs to regional building categories
  - Regional datasets are limited to approx. 14 building categories
- Compare CBECS zonal mean EUIs to mean EUIs from other data sets
  - CBSA, Seattle Benchmarking, Portland Benchmarking, and others
  - Find statistical characteristics for each data set
    - Do mean EUIs have comparable statistical results (±1σ)?
    - Do the variances overlap the means?



Develop Regionally Adjusted Zonal (RAZ) Mean EUIs for EUIt Building and Property Types

- Create adjustment factors for 14 regional building categories
- Re-check regionally adjusted zonal mean EUIs against statistical criteria

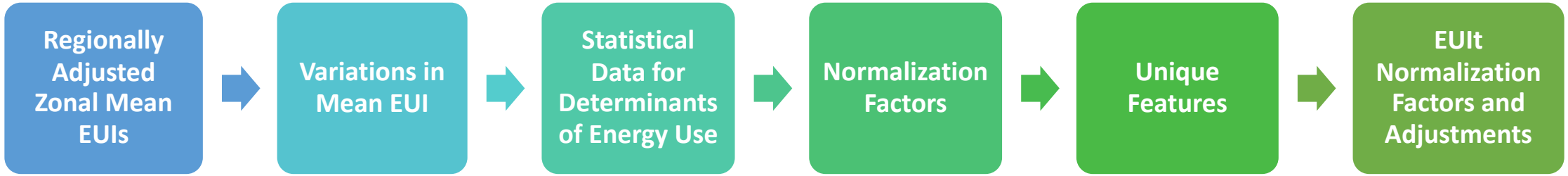
Assemble Baseline Mean EUIs for Newer Construction

- Possible data sources:
  - State Building Code Council 2006 baseline development project (in progress)
  - NEEA/Commerce commercial energy code technical roadmap (in progress)
  - Regional new construction baseline surveys
  - 2021 NW Power Plan analysis
  - Other new construction and/or energy code related baseline means
- Methods:
  - Assemble comparable baseline datasets
  - Compare baseline mean EUIs
  - Use findings from comparisons to develop an approach to best establish new construction mean EUIs

EUI Target Methodology

STEP 2: DEVELOP NORMALIZATION FACTORS & ADJUSTMENTS

Target Normalizations & Adjustments Overview



Analyze Variations in Energy Use

- Normalization factors and adjustments support
  - Use normalizations for determinants of Energy use from the body of literature (Energy Star, ASHRAE, IEEC, etc.)
  - Verify that determinants of energy use show impacts within the data where possible
- CBECS regionally adjusted building/property EUIs
  - Use CBECS 2012 Regionally Adjusted Zonal Mean EUI data to identify variations resulting from Determinants of energy use
  - Compare to impacts from determinants of energy use in regional data
  - Adjust from regional observations if needed

Operating Shifts

- ASHRAE 100 outlines an approach to normalize operating shifts
  - Normalizations were developed from 2003 CBECS data
  - We will verify that they are applicable in 2012 data, or create new normalizations as needed

Table 7-3 Building Operating Shifts Normalization Factor

No.	Building Activity/Type	Weekly Hours		
		50 or Less	51 to 167	168
1	Admin/professional office	1.0	1.0	1.4
2	Bank/other financial	1.0	1.0	1.4
3	Government office	1.0	1.0	1.4
4	Medical office (nondiagnostic)	1.0	1.0	1.4
5	Mixed-use office	1.0	1.0	1.4

Unique Features

- Some building/property features *may* merit additional analysis
  - We will develop a list for consideration
  - Process loads, EV charging, Others TBD…
  - Analyze impacts on mean EUIs
  - Recommend a process to manage exempted features

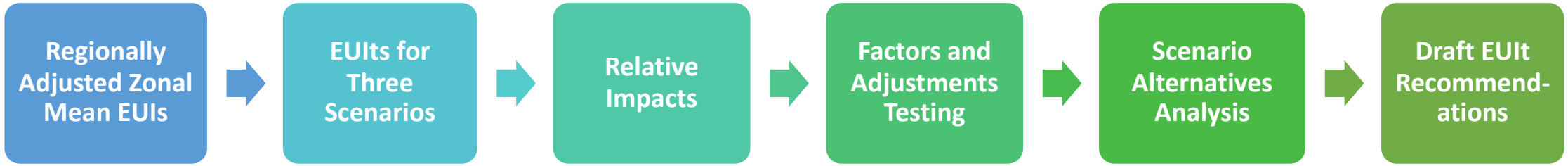
Other Considerations

- Factors with less clear impacts
  - Occupant Density, Vintage, Large equipment loads, etc.
- Support from data
  - Analyze the impacts of these factors while examining variances in regionally adjusted mean EUI data
  - Recommend further normalizations and adjustments if they are supported by the analysis

EUI Target Methodology

STEP 3: CALCULATE EUI TARGETS

Target Development Overview



Identify Three EUI Target Scenarios Using % Reductions from Mean EUIs

Scenarios for 2025 Washington Building Performance Standard (WBPS), effective in 2026-2028:

EUI Target Scenarios	2025 WBPS	Newer: 2025 WBPS
Scenario 1	Mean	%<2006
Scenario 2	%<Mean	%<2006
Scenario 3	%<Mean	%<2006

Calculate EUI Targets by Building Type & Climate Zone

Apply % reductions to Regionally Adjusted Zonal (RAZ) Mean EUIs by building type for each EUI target scenario:

	Scenario 1: X% < RAZ Mean EUI			
	EUI Targets: Existing		EUI Targets: Newer Construction	
Building Type	4c	5b	4c	5b
Library				
Medical Office				
Office				
Retail Store				
Etc.				

Build Tables for Basic State-Level Baseline and Targets (BaT) Model

- Model intended for high-level analysis to estimate relative magnitude of reductions for various scenarios
  - Model structure based on simplified utility conservation potential assessments using end-use EUI reductions, NOT individual measures or saturations
- Rollup EUI targets to building category level (approx. 14) for analysis
- Populate BaT tables with outputs from the mean EUI development and analysis in Steps 1 and 2 above:
  - Commercial building population totals, total SF by building type category
  - Total building and end use EUIs by fuel type
  - EUI distributions by size, vintage, etc.
  - Other relevant inputs

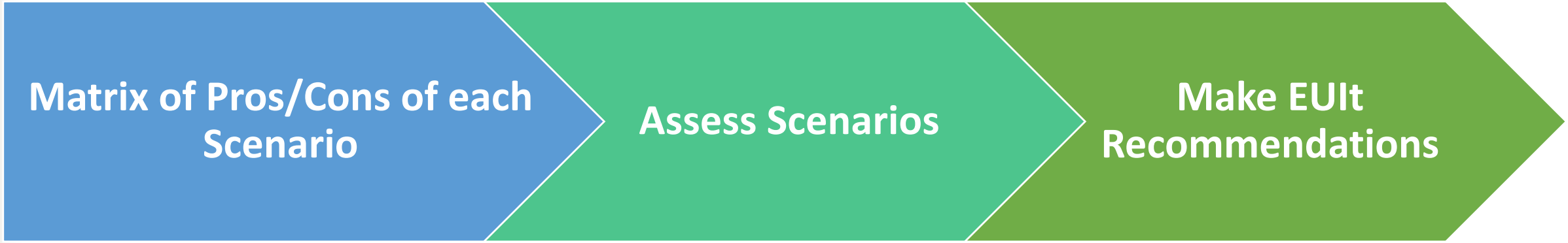
Use Bat Model to Assess Targets Against Target Setting Criteria

- **Estimate relative magnitude of energy and GHG reductions**
  - Targets used as new mean EUI inputs to determine impacts of 2025 WBPS
  - Reductions in mean EUIs will be multiplied across the overall square footage of buildings greater than 50k SF aggregate building type to provide a rough estimate of sector-level energy and GHG savings
  - End use fuel splits provide basis for GHG estimates
- **Identify high-level technical path for reductions**
  - Examples of basic Energy/GHG reductions strategies for main building systems will be drawn from 2021 NW Power Plan supply curves, WA state and local energy codes, and various sources for high-performance retrofits. For example, for building operations, lighting, envelope, HVAC, and service water systems.
  - However, end use EUI reductions applied in BaT model will be ratio based, e.g. X% reduction in lighting, Y% reduction in HVAC, etc.
- **Discuss implications for market and utility adaptation and make high-level recommendations for ancillary support**

Test-Run EUIt Normalization Factors and Adjustments

- Apply series of possible factors and adjustments to a subset of building types
- Reasonableness check on impacts

Conduct EUI Target Scenario Alternatives Analysis and Make Recommendations



FINAL TARGETS & REPORTING

Final Targets & Reporting

- Present key findings and draft targets to Commerce and the public
- Revise targets based on input
- Draft a report, including:
  - Methodology
  - Key findings
  - Final EUI targets for CR102
  - High-level recommendations/input for market capacity building and ancillary programs and policies

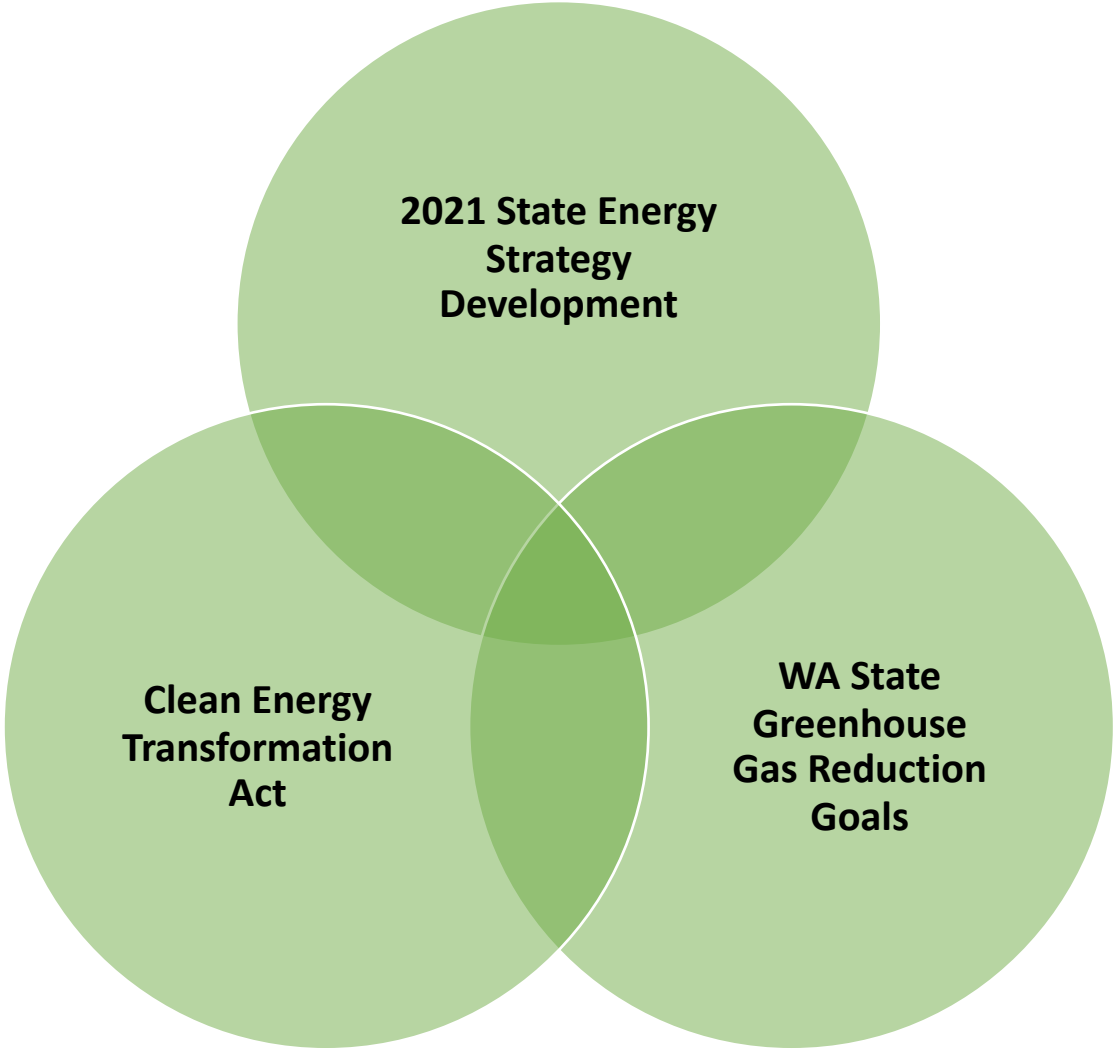
CONSIDERATIONS FOR A FUTURE POLICY FRAMEWORK

GHG Reduction Goals May Drive Future Target Setting Framework

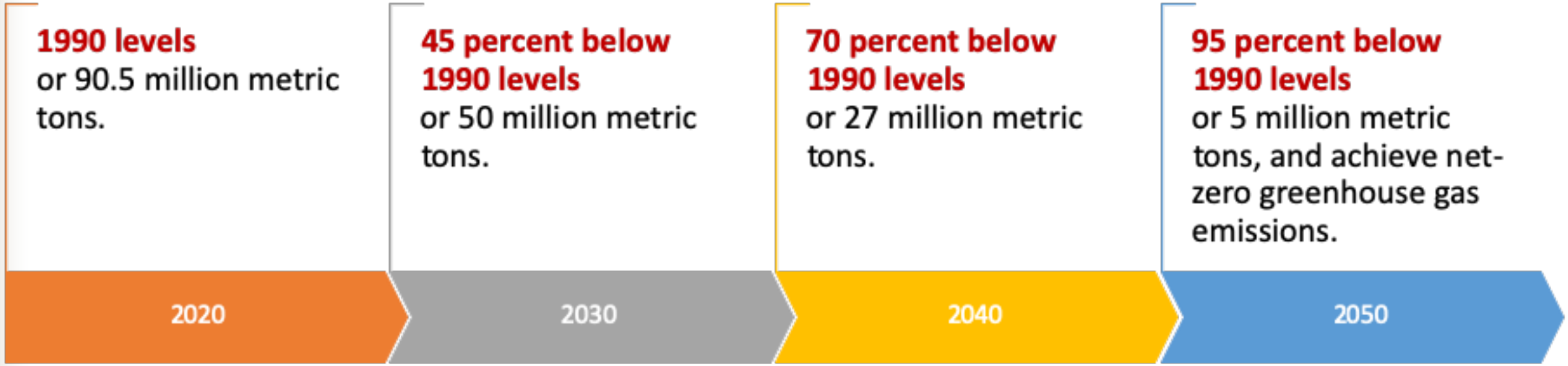
Washington Building Sector Emissions

HB 1257: “Buildings represent the second largest source of greenhouse gas emissions in Washington and emissions from the buildings sector have grown by fifty percent since 1990, far outpacing all other emission sources.”

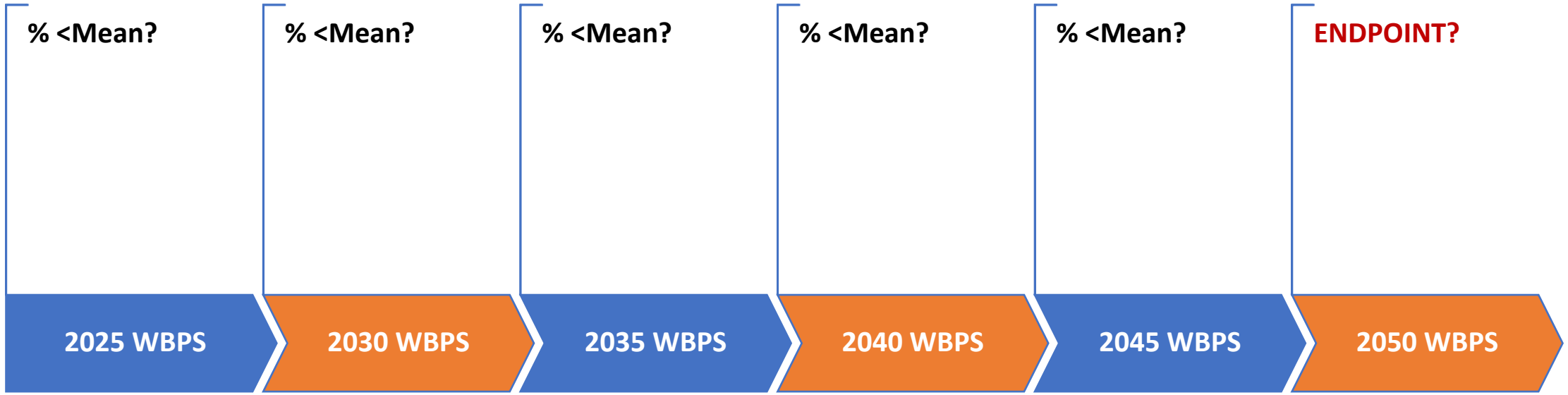
Building Sector Policy Context



State Emission Reduction Goals Under Consideration in 2020 Legislative Session (HB 2311)



Future Policy Analysis May Explore How 2025 WBPS Fits into Future Updates & an Endpoint Framework for Target Setting



EUI Target Development Process